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LUMINEU: a search for neutrinoless double beta decay based on ZnMoO4 scintillating bolometers

The "Luminescent Underground Molybdenum Investigation for NEUtrino mass and nature" (LUMINEU) aims at setting the bases for a next-generation neutrinoless double beta decay experiment capable to explore deeply the inverted hierarchy region of the neutrino mass pattern by means of a large array of scintillating bolometers based on ZnMoO4 crystals containing the favorable isotope 100Mo. These hybrid detectors, able to measure both the scintillation light and the heat generated by an interacting particle, are in fact very promising tools in double beta decay search in terms of efficiency, energy resolution and alpha-background rejection capability. Simulations and preliminary results confirm that the LUMINEU technology can reach zero background in the region of interest (around 3 MeV) with exposures of the order of hundreds kg x y. In this contribution we present the LUMINEU concepts and the experimental results achieved aboveground and underground with large-mass natural and enriched crystals. In particular, the performance of a 300 g single-module detector is described in detail. The measured energy resolution (a few keV at the double beta decay transition energy), the alpha/beta discrimination power and the radioactive internal contamination are all within the specifications for the projected final LUMINEU sensitivity. Detectors based on enriched crystals have been tested as well, confirming the excellent results obtained with the natural ones and showing deterioration of none of the crucial detector parameters. LUMINEU's next steps are illustrated, in particular a pilot experiment containing at least 1 kg of isotope. Finally, an immediate LUMINEU follow-up is discussed, consisting of an array of about 40 elements containing 10 kg of enriched molybdenum. The sensitivity of this set-up is similar to the one of the current major double-beta decay experiments and already approaches the onset of the inverted hierarchy region.

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